EAST Browser - L17: (8) L16 and (sin... | US 6014999 A | Tag: S | Doc: 2/8 | Format : KWIC

File Edit View Tools Window Help

EAST Advanced Find

Find what: sink

Find Next

Area: All / Sel/Cur

Direction: Up / Down

Match word: Whole / Left / Part / Right

Look in: Documents

Match case

Close

Help

slot opening that allows
the ram blade 28 to optimally shear the prepreg 3. A clamp bar 9 holds the
prepreg 3 in place with a defined force determined by a spring 10 or other
controlled compression force device. Anti-friction surfaces 11 allow the ram
blade 28 to freely move and to be held in place by the clamp bar 9. Alignment
rails 61 guide the ram assembly 29 during operation. Side guides 60 keep the
width of the prepreg 3 aligned with the slot 66.

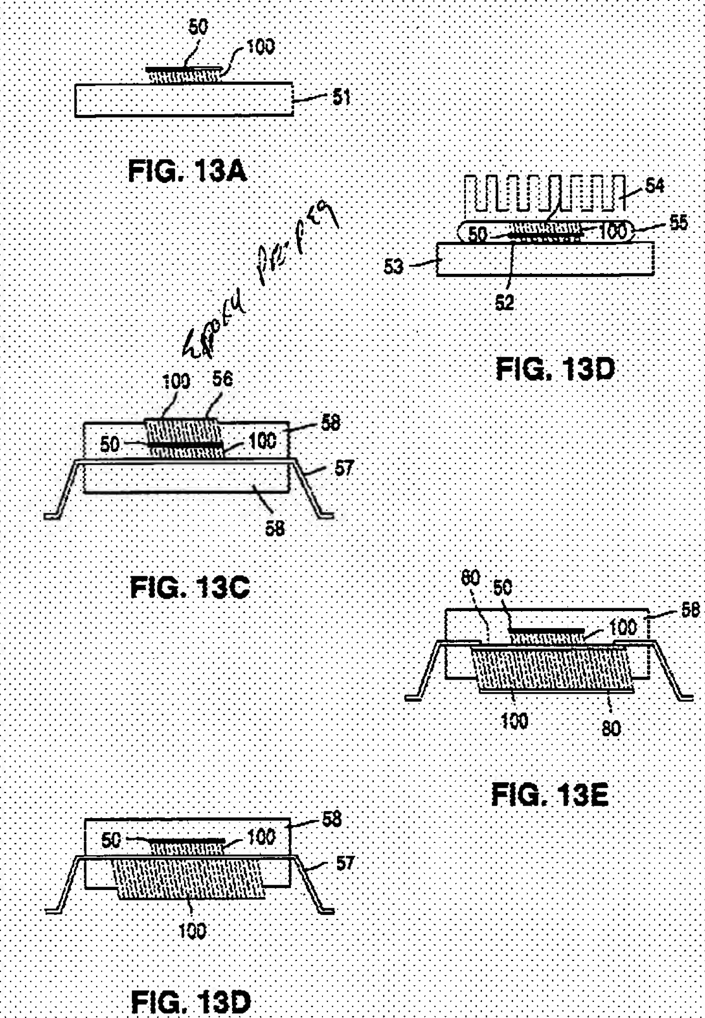
Detailed Description Text - DETX (82):
FIGS. 5A to 5D illustrate the process of making the thermally conductive
joining film 100 of the present invention using the shear/extruder apparatus
101. After the prepreg 3 is formed, the prepreg material is cooled (if
necessary) and fed in the direction of arrow A into the shear/extrusion
apparatus 101 as shown in FIG. 5A. The ram assembly 29 is then moved forward
in the direction of arrow B toward the prepreg 3 by a cam, crankshaft or other
controlled motion mechanism, as illustrated in FIG. 5B. The clamp bar 9 makes
initial contact with the prepreg 3 and holds it in place with a clamping force
from the compressing spring 10. The ram assembly 29 continues to move forward
until the ram blade 28 contacts the prepreg 3 and causes a shearing action
between the ram blade shearing edge 7 and the top die block shearing edge 6. A
clean shear fracture 14 forms in a characteristic shear fracture "V" shape,
which is described in further detail below.

Detailed Description Text - DETX (92):
The fiber-to-film surface angle .theta. can also (or further) be affected
by introducing the prepreg 3 into the shear/extruder apparatus at an angle,
either in the forward direction as illustrated in FIG. 11A, or in a sideways
direction (from either side) as illustrated in FIG. 11B. The die blocks 4/5
and/or the side guides 60 can be specially formed to aid feeding the prepreg 3
into the shear/extruder apparatus 101 at the desired angle to produce the
desired fiber-to-film surface angle .theta. for the film exiting the extruder
slot 66.

Detailed Description Text - DETX (96):
FIGS. 13A to 13E illustrate several applications of the joining film 100 of
the present invention. FIG. 13A shows a semiconductor device 50 die bonded by
the film 100 to a heat sink 51. FIG. 13B shows a semiconductor device 50
directly attached to a printed circuit board 53 by a ball grid array (BGA) of
solder balls 52. A heat flow path is provided out of the device by the film
100, that directly thermally connects the device 50 with a heat fin 54. An
underfill 55, common to BGA packaging, seals off the device. FIG. 13C shows
the film 100 being used as a self-bond heat sink 56 on top of device 50, where
the film 100 takes the place of a heat sink, typically a copper slug, to
provide a heat path to the outside of an electronic
package. The device 50 is

Browne

U.S. Patent Jan. 18, 2000 Sheet 12 of 12 6,014,999



EAST Browser - L17: (8) L16 and (sin... | US 6014999 A | Tag: S | Doc: 2/8 | Fo

File Edit View Tools Window Help

Find what: sink

bottom surface of the film.

Detailed Description Text - DETX (50):

FIG. 3 illustrates a coating 59 formed on the fiber 1 using standard techniques to give the fibers desirable properties. For example, coating 59 can be added to produce the desired thermal and electrical conductivity or magnetic properties. Coating 59 could also be added to aid curing of the matrix material 2. The orientation of the fiber in the matrix allows light to go all the way through the film's thickness provided the matrix is sufficiently transparent. In most conventional composites the fibers are plane orientated and the first layer of fibers absorbs the light. A reflective coating on the fiber will make them act as parallel mirrors and will enhance the transmission of light down into the film. Preferred examples would be aluminum, silver or gold coatings. Light transmission can also be enhanced by the addition of transparent fibers parallel to the thermally conductive fibers. A preferred example would be quartz fibers. Fiber coatings could aid other electromagnetic energy assisted cures. An absorptive coating would absorb the curing energy, converting it into heat, and the thermal conductivity of the fibers would efficiently transmit it throughout the entire film layer. A carbon and/or metal coating would be a preferred example for microwave, induction, or electron beam curing techniques.

Detailed Description Text - DETX (80):

A method and shear/extruder apparatus 101 for making the above described thermally conductive joining film 100 from a sheet of prepreg composite material is described below and illustrated in FIGS. 4A and 4B. The shear/extruder apparatus includes a ram assembly 29, and an extrusion slot 66. The extrusion slot is formed by a top die block 5, a bottom die block 4 and walls 65. The top die block 5 has a sharpened shearing edge 6 on it to aid the shearing operation. The top and bottom die blocks are clamped or bolted together with walls 65 therebetween. The ram assembly 29 has a ram blade 28 that provides the shearing action and rams the cut material into the slot 66. The ram blade has a face 8 with a sharpened shearing edge 7. The face 8 is oriented at an angle .phi. relative to the extrusion slot opening that allows the ram blade 28 to optimally shear the prepreg 3. A clamp bar 9 holds the prepreg 3 in place with a defined force determined by a spring 10 or other controlled compression force device. Anti-friction surfaces 11 allow the ram blade 28 to freely move and to be held in place by the clamp bar 9. Alignment rails 61 guide the ram assembly 29 during operation. Side guides 60 keep the width of the prepreg 3 aligned with the slot 66.

Detailed Description Text - DETX (82):

FIGS. 5A to 5D illustrate the process of making the thermally conductive joining film 100 of the present invention using the shear/extruder apparatus 101. After the prepreg 3 is formed, the prepreg material is cooled (if necessary) and fed in the direction of arrow A into the shear/extrusion apparatus 101 as shown in FIG. 5A. The ram assembly 29 is then moved forward in the direction of arrow B toward the prepreg 3 by a

U.S. Patent Jan. 18, 2000 Sheet 1 of 12 6,014,999

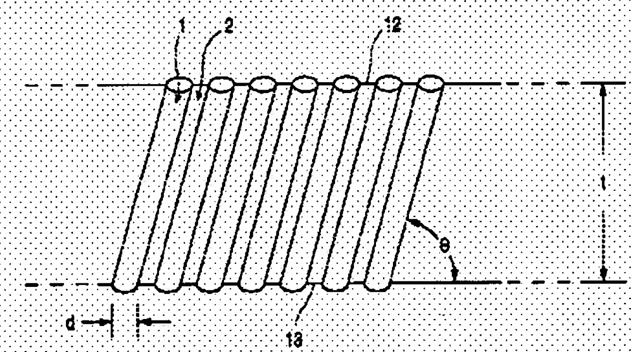


FIG. 1

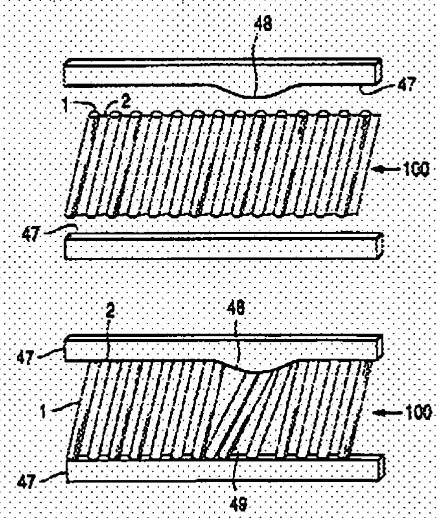


FIG. 2A

FIG. 2B

EAST Browser - L17: (8) L16 and (sin... | US 6014999 A | Tag: S | Doc: 2/8 | Format : FULL

File Edit View Tools Window Help

blade 28.

(87) The shape and location of the "V" shaped shear fracture 14 is dictated by the prepreg composite material and by the angle .phi. of the ram blade 28. If the ram blade angle .phi. is too large, the "V" shaped shear fracture 14 will be too deep and will cause compressive compaction problems. If the ram blade angle .phi. is too small, then the shear fracture line 14 will be too high above the shearing edge 6 so that the sheared pieces 16 will not fit into the extrusion slot 66.

(88) FIGS. 7A to 7C illustrate vertical consolidation of the film 100, which is the squeezing of the film that occurs either during processing after the film has left the extrusion slot or during fabrication of a joint. FIG. 7A illustrates the film 17 is as it typically leaves the extrusion slot 66. This film is not ideal as a bonding film at this point because it's top and bottom surfaces 21/22 are ridged resulting from the original "V" shaped shear fracture 14. Vertical consolidation is accomplished by compressing top and bottom surfaces 21/22 together to form smooth surfaces. FIG. 7B illustrates the state of the softened film 100 after the film compression process has started where the first contacts have been made by fiber ends to the surfaces 21/22. The surface ridges are starting to disappear. The stiffness of the fibers is enough that they will spear through the matrix when pushed by a surface contact on one end. If enough compressive compaction is applied, nearly all of the fibers will make contact with both surfaces 21/22. FIG. 7C shows the completely compressed film 100. The film surfaces 21/22 are smooth and the fibers are in contact with the film surfaces on both ends.

(89) FIGS. 8A to 8C illustrate an apparatus for consolidating the film 100. The film leaving the extrusion slot 66 is fed directly into the slot 33 of a consolidation mold 32 consisting of a top plate 34, a bottom plate 35, and compressible slot spacers 40 that act as side walls. A spacer ram 36 provides back pressure on the film material as it is fed into the mold slot 33. As shown in FIG. 8C, after enough film is placed in the mold 32, it is removed from the end of the extrusion slot 66. The spacer ram 36 is removed and a pair of mold dams 39 are inserted into the ends of the compressible mold slot 33. The mold is then put in a press where the film is compressed. Shims may be inserted into the slot 33 to control the final thickness of the film. For gaskets that require pressure sensitive adhesive (PSA) properties, a PSA adhesive can be coated on the surfaces of the mold before the film is fed in, or the PSA adhesive can be coated on the gasket after the film is cured, or a matrix material can be chosen that has PSA properties on its own.

(90) FIG. 9A and 9B show another apparatus for consolidating a long length sheet coming out of the extrusion slot 66. Belts 42 driven by rollers 43 form movable top and bottom walls to slot 37 formed therebetween. The sides of the slot 37 are formed by compressible belt spacers 41 that are on the outside edges of one of the belts 42. Pressure, and heat if

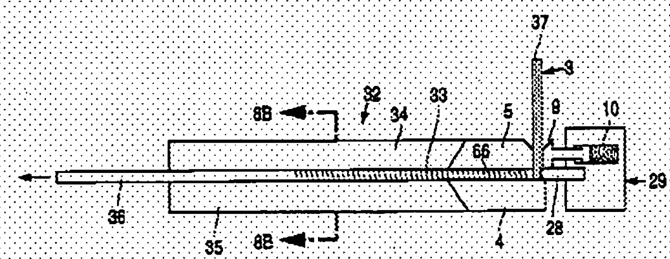


FIG. 8A

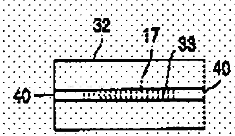


FIG. 8B

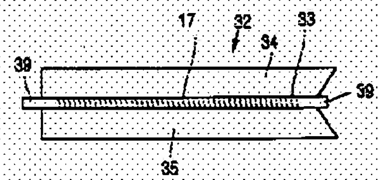


FIG. 8C

FIG. 14A

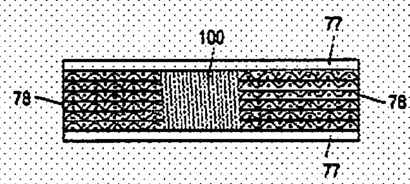
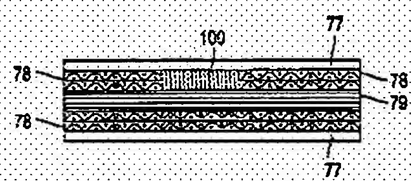


FIG. 14B



EAST Browser - L7: (16) L4 and (micr... | US 5844217 A | Tag: S | Doc: 5/16 | Format : FULL

File Edit View Tools Window Help

Find what: 421 Find Next

Area: All / Sel/Cur — Direction: Up / Down — Match word: Whole / Left / Part / Right — Look in: Documents — Match case — Close — Help

control of ports p1, p2 and p3 into cavity 400.

DETAILED DESCRIPTION:

(1) DESCRIPTION OF PREFERRED EMBODIMENTS

(2) The present invention relates to a method for forming an article of a cured thermoset polymer which comprises: providing a mold with metal walls defining a cavity, with an injection port for introducing a curable liquid polymer composition into the mold, with multiple ports with covers which allow transmission of electromagnetic waves selected from the group consisting of radiofrequency waves and microwaves into the cavity and with means for removing gas from the mold before or during injection; introducing the curable liquid resin composition through the injection port into the mold; heating to induce curing of the resin by the electromagnetic waves through the multiple ports so as to provide uniform heating in the cavity of the mold and to provide the article; and removing the article from the mold.

(3) The present invention also relates to an apparatus for forming a cured resin article which comprises: a mold with metal walls defining a cavity, with an injection port for introducing a curable liquid polymer composition into the mold, with means for removing gas from the mold before or during the injection and with multiple ports into the mold for introducing electromagnetic waves selected from the group consisting of radiofrequency waves and microwaves into the mold; dielectric covers over the ports which allow transmission of the electromagnetic waves into the cavity; and multiple microwave applicators mounted over the ports for introducing the electromagnetic waves into the mold, wherein the electromagnetic waves provide uniform curing of a liquid resin in the cavity of the mold to produce the article.

(4) Microwave or radiofrequency wave processing is more efficient than conventional thermal processing because the microwave or radiofrequency wave energy is coupled with the material directly on the molecular level, bypassing the air medium in the cavity. Such electromagnetic (EM) processing also has potential for rapid processing of thick-section composites. Electromagnetic processing scales with wavelength or frequency; e.g., the same resonant modes in a 17.8 cam cylindrical cavity at 2.45 GHz can be attained in a 45.7 cm cylindrical cavity at 915 MHz. Microwave processing of homogeneous, isotropic, lossy materials, such as matrices and glass fiber composites, was successfully scaled from 17.8 cm cavity to 45.7 cm cavity.

(5) The features of EM processing versus thermal processing are summarized as follows: (1) EM processing is rapid and selective, (2) EM heating is believed to enhance reaction rate with the magnitude of enhancement depending on the curing agent (i.e. increased by factor of five for

Hawley et al

cite

cavity

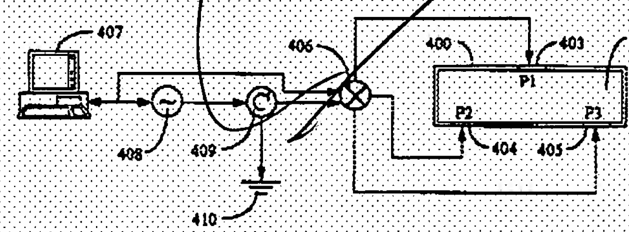


FIG. 22

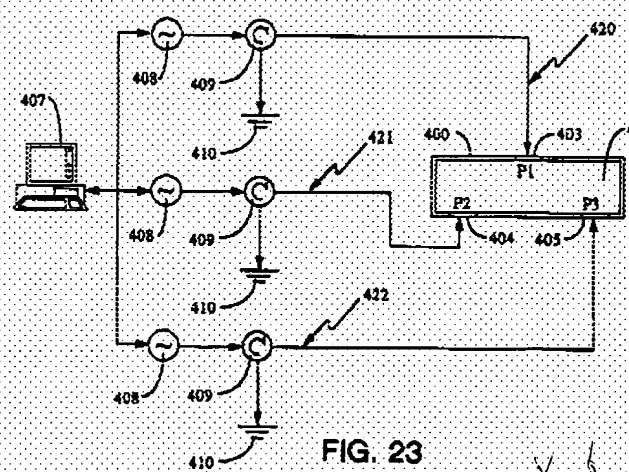


FIG. 23

not meant to direct to only epoxy